

## CHAPTER 16E

### ALUMINUM CONDUCTORS

#### 16E-01 GENERAL

The information included is important because of recurring and serious problems in public and private construction where aluminum conductors are used in the wiring system. We permit a limited use of aluminum conductors. Special skills and tools are required when making connections and terminations with aluminum conductors.

#### 16E-02 MATERIAL

##### a. Conductors

(1) The electrical systems shown on drawings indicate copper wire size given in gauge number, American Wire Gauge (AWG).

(2) Aluminum is permitted only for copper wire sizes No. 6 AWG and larger.

(3) Aluminum wire size substitutions for copper wire must have ampacity of not less than the copper wire size shown. The tables in Article 310 of the National Electric Code (NEC) show the allowable ampacities of insulated copper and insulated aluminum conductors. The correct size aluminum wire can be determined by using the ampacity value for copper wire in a given size in the aluminum conductor table. The equivalent temperature rating of the conductor must match-up with the conductor being installed.

##### b. Bolts, Nuts and Washers

(1) Check these materials for proper alloy and finish. An anodized finish may be required.

(2) Plain, standard series flat washers are required;  
Narrow series washers cannot be used.

##### (3) Antioxidant Joint Compound

Use approved oxide-inhibiting joint compound when making-up aluminum conductor/pressure fitting connections and at bus bar connections.

##### (4) Connectors

(a) Pressure connectors must be tinned aluminum bodies.

(b) Must be rated for use with aluminum conductors.

(c) Must be required size, material, and tightened to specified torque.

#### 16E-23 INSTALLATION

##### a. Conductor Size

(1) Aluminum wire used must be number 4, AWG or larger.

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(2) Check for the equivalent aluminum gauge size as the size shown on the drawings is for copper.

b. Removing Insulation

(1) Check removal or stripping method; wire should not be damaged. Recommended methods are:

Whittling - Using a knife as in sharpening a pencil.

Peeling - Using a knife from the end of the conductor to peel back, and cut off the insulation, cutting away from the wire.

Stripping - Using the proper size stripping tool. A tool that will nick or ring the wire shall not be used. (Ringing is to cut the wire over its circumference)

(2) Wire conductors which are nicked or ringed should have damaged portion removed and the conductor properly prepared.

(3) A nick or ring reduces conductor ampacity and introduces a weak point.

c. Surface Preparation

(1) Check for clean surface.

(2) Wire may require wire brushing to assure aluminum oxide is removed.

(3) Cleaning may require a coating of antioxidant joint compound and a second wire brushing.

(4) Check for the required coating of antioxidant joint compound on wire immediately before the connection is made.

(5) On aluminum bus bars check for silver plating at connection point surfaces.

(6) Also check for a light coating of antioxidant joint compound at bus bar connections.

d. Connections

(1) Are bolted connections tightened with an approved calibrated torque wrench?

(2) Check that compression connectors are applied with the proper tool and force.

(3) Are screw connections properly torqued?

(4) Are terminal lugs and connectors made from approved materials? Must be of aluminum and tin and so labeled. Also cap be nickel plated copper.

(5) Are compression terminals and connectors tightened with the special tool?

(6) Screws of bolt type terminals and connectors must be tightened with an approved, calibrated torque wrench.

(7) Check torque wrenches for calibration by an approved testing firm. These wrenches are designed to slip when the present torque is exceeded.

e. Connection to Vibrating or Cycling (Intermittent Duty) Equipment

Aluminum conductors are not recommended for this equipment. Use standard or solid copper conductors as specified.

(1) Check for use of aluminum conductors to vibrating equipment. Extreme movement and vibration induces stresses in aluminum wire. Aluminum wire has poor workability.

(2) Check for use of aluminum conductors in cycling equipment. The aluminum conductor receives high current and stress each time equipment is energized. This causes connections to loosen from creep.

16E-04 ENVIRONMENTAL CONDITIONS

Conditions which can effect Aluminum Conductors

(a) Salt water, air pollution and high relative humidity conditions or corrosive soil will accelerate corrosion of unprotected aluminum wire.

(b) Extreme changes in the ambient temperature will adversely affect workability and the extent of creep and oxidation.

(c) When any of these conditions are present check for use of aluminum conductors. When used, check for a protection tape wrap for the exposed bare aluminum wire. Apply oxide- inhibiting joint compound to the surface of exposed connectors and terminals.

16E-05 INSPECTION AND ANALYSIS

a. Wrong wire size? Aluminum wire gauge must be No. 4 AWC or larger. See Article 310, NEC, for aluminum equivalent size for copper size shown.

b. Is the conductor ringed or nicked? Disapprove and require a new section of undamaged conductor be prepared using proper methods.

c. Terminal material must be bi-metallic when copper and aluminum are used on the same terminal or bus. Check for stamped letters "AL-CU" for an approved bi-metallic terminal. Check for both proper size and type of terminals and connectors.

d. Is aluminum bus, silver plated at the connection point surfaces? If not, disapprove, as it must be factory plated.

e. Is aluminum wire cleaned and coated with oxide-inhibiting joint compound immediately before making connections?

f. Is an approved, calibrated torque wrench used to tighten bolted and screwed connections? Check calibration date for being recent.

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g. Check for proper crimping tool use in compression connections.

h. Is connection loose or otherwise poorly made? After electrical system is activated check for:

(1) Voltage drop across the connection (there is no voltage drop across a good connection)

(2) Discoloration of the aluminum wire and/or insulation at the connection : gray-white color coating on the wire indicates aluminum oxide corrosion. A brown-black color on the insulation, or if the insulation is brittle, indicates a failure.

i. A "Hot Spot Check" with an infra-red scan will indicate thermal build-up at points of failure.